be obtained at Saigon. That it must be tolerably full, however, appears from the list of serpents, of which there are 87 in all, 17 being poisonous, the rest harmless. The scientific name, the Annamite and Cambodian names, are given in each case.

The inscriptions scattered all over Cambodia, which, like the great ruins of Angkor, have come down from an earlier civilisation which has otherwise disappeared, have attracted much attention, and have now apparently reached a stage in which scholars are violently quarrelling about them. Papers on them, generally accompanied by copies of the inscriptions, appear in every number of the periodical. M. Aymonier was specially sent out from France to study them, and in less than three years he succeeded in obtaining a *corpus* of about 350 inscriptions. These are in many languages, the principal, however, being in Khmer, or ancient Cambodian; and their examination has thrown much light on the history of Cambodia in ancient times, and possibly on the ethnological problems of the Indo-Chinese peninsula. The general result of the investigation so far, represents the distribution of the inhabitants of the southern part of the peninsula in the first centuries of the Christian era as follows:—The Annamites were still confined to Tonquin, while the Chams occupied the coast of the present Annam; tribes more or less numerous called Chongs, Kouis, Samre, &c., occupied the present Cambodia and Southern Laos. Probably their social state was more advanced than that of the tribes still existing between the valley of the Meikong and the coast of Annam. The Laotian people spread along the valley of the Meikong from Luang Prabang in Siam to Lokhon, while the Siamese were scattered about in principalities in the centre of the country now occupied by them. There existed a primitive religion amongst all these tribes: in April they rendered homage to the spirits of the high places, and in October they offered of the fruits of the earth to the *manes* of their ancestors. They knew of the use of iron and made arms and tools for themselves, and they cultivated rice. Then came Indian traders, who penetrated by the Meikong River, founded small colonies, and reduced some of the natives to slavery. They established independent states, and from them we get the name Cambodia, originally a title of honour. Thus the present population of Cochin China is the result of two totally distinct races and civilisations—Indian and the aboriginal native. The inscriptions give the history of the Khmer dynasty down to the twelfth century.

M. Landes writes on the folk-lore of the Annamites, while M. Aymonier has another long paper entitled "Notes on the Laos," being a series of observations made during journeys in the Laos country, which he has not been able to work up into a connected paper on this curious people. They embrace every conceivable subject relating to the Laos: the geography of the country, their ethnological features, customs, rites. There are up to the last issue seventy-nine of these notes, referring to as many different points connected with these tribes.

A lengthy report by Dr. Burck, Director of the Botanical Garden at Buitenzorg, in Java, is printed. It contains an account of his exploration in the highlands behind Padang, on the west coast of Sumatra, in search of the trees which produce guttapercha. The present state of the subject is this: Specimens of guttapercha are found in considerable quantities in trade, but it is impossible with our present knowledge to determine the botanical origin of a single one of these specimens. The *Dichopsis gutta* (Benth.), the *Isonandra gutta* of Hooker, is the only species of tree producing guttapercha of which botanical specimens have been sent to Europe. But it has never been exactly and completely described, for no man of science has seen the fruit or seeds in their maturity. No one can at present affirm with certainty the origin of such or such a kind of guttapercha in trade. Dr. Burck maintains that the tree has never been found at Singapore and that since the disappearance of the forests there no one can affirm that the *Dichopsis gutta* can be found in its wild state. The paper is of considerable length and the writer disputes certain statements in the Kew reports with reference to the trees producing guttapercha and the places where they are found. An account of a journey in Siam and a translation of a long Tonquinese poem with copious explanatory notes and an excursus on Annamite literature are the remaining papers of these three numbers, the product of six months' work. At this rate the eastern part of the Indo-Chinese peninsula cannot long remain unknown to Europe.

Since the above was in type we have received the succeeding number (vol. ix. No. 22) of the periodical here referred to. It contains a report from M. Aymonier on a further journey of his in search of inscriptions, and describing in some detail the tribe of Chams in Cambodia. He promises a complete work later on this tribe in the province of Binthuan, which have been almost wholly unknown hitherto. The same writer concludes his valuable notes on the Laos, the present instalment dealing with the Kouis, the Khmers, and the province of Korat. These notes occupy more than half the whole number, and, in the present state of our knowledge of the Laos tribes, are simply invaluable, supplying as they do the results of long and close observation on the part of the only European traveller who has yet had an opportunity of living and travelling amongst them. M. Baux has a short encyclopædia sort of article on tea, which is of no especial note. M. Landes continues his folk-lore of Annamites, under the title "Contes et Légendes Annamites." So far he has given fifty popular tales and fables, in which we find many old friends. Androcles and the lion reappear, for example, as the midwife and the tigress, the reward being a pig caught by the latter and carried as a present to the woman. Dr. Tirant, having concluded his study of the reptiles, commences in this number a paper on the fishes of Lower Cochin-China and Cambodia. Fishes play here a preponderating zoological *rôle;* Southern Indo-China forms an ichthyological province closely allied with Malayasia; Lower Cochin-China in particular has curious affinities in this respect with Borneo. The present number contains only the first instalment of Dr. Tirant's "Notes," as he modestly styles a paper of great research and investigation.

ON THE MEASUREMENT OF MOVEMENTS OF THE EARTH, WITH REFERENCE TO PROPOSED EARTHQUAKE-OBSERVATIONS ON BEN NEVIS [1]

MEASUREMENTS of earth-movements are of two distinct types. In one type the thing measured is the displacement, or one or more components of the displacement, of a point on the earth's surface. For this purpose the mechanical problem is to obtain a *steady point,* to be used as an origin of reference, and this is effected by making use of the resistance which a mass opposes to any change of motion. This may be called the *Inertia* method of observing earth-movements. It is applicable to ordinary earthquakes, and also to the more minute earth-tremors which would pass unnoticed if instrumental means of detecting their presence were not employed. The steady point is to be obtained by suspending a heavy mass (with one, two, or three degrees of freedom) in such a manner that its equilibrium is very nearly neutral. Any moderately sudden displacement of the ground in the direction in which the mass has freedom to move leaves the mass almost undisturbed, and the displacement of the ground is therefore easily measured or recorded by a suitable autographic arrangement, which must be so designed as to introduce exceedingly little friction.

The second type of measurement is that in which the thing measured is any change in the inclination of the surface of the ground relatively to the vertical. Movements of this class have been examined by d'Abbadie and Plantamour, and also by G. H. and H. Darwin, who have given the results of their observations to the British Association in two reports on the lunar disturbance of gravity (1882-3). Perhaps the most convenient name for these movements is "earth-tiltings." They are measured by what may be called the *Equilibrium* method. A pendulum, suspended in a viscous fluid, is employed to show, by its equilibrium position, the true direction of the vertical, and that is compared with the direction of a line which is fixed relatively to the surface of the ground; or, instead of a pendulum, a dish of mercury or a pair of spirit-levels are employed to define a truly horizontal surface, and the tilting of the earth's surface relatively to that is observed. This method is practicable only when the displacements of the surface have so great a vertical amplitude, in comparison with their horizontal wavelength, that the slope of the wave is sensible; and, further, only when the changes of slope occur slowly enough to put the inertia of the pendulum or fluid out of account.

On the other hand, the inertia method is applicable only when the displacements have so short a period, in comparison with their amplitude, that the acceleration of the ground, during

[1] Paper read before Section A of the British Association at Aberdeen, by Prof. J. A. Ewing, of University College, Dundee. (Abstract.)

the greater part of the motion, is large relatively to the frictional resistance of the suspended mass.

Between ordinary earthquakes and tremors, on the one hand, capable of observation by the inertia method, and slow earth-tiltings, on the other, capable of observation by the equilibrium method, it is at least possible that there may be many movements, not reducible to either type. For example, if successive upheaval and subsidence of small amplitude were to occur with a very long horizontal wave-length, and with a period of (say) one or two minutes or more, it would be practically impossible even to detect its existence by either of the methods named, unless by chance it were repeated several times with uniform period in the presence of a very frictionless vibrator whose free period happened to agree nearly with the period of the disturbance; even then, no measurement of its amount could be made. We are in fact forced to classify earth-movements under the two heads which have been named, not because there is any necessary discontinuity between the two, but because they must be treated by two entirely distinct modes of observation.

For the measurement of palpable earthquakes by the inertia method, the writer has devised many instruments which have been successfully applied to the registration of Japanese earthquakes, and which are described in a memoir on earthquake measurement, published in 1883 by the University of Tokio. He has not attempted in any case to give the astatically suspended mass three degrees of freedom, and nothing would be gained by doing so. An instrument with two degrees of freedom is now exhibited to the Association. It consists of an ordinary pendulum coupled with an inverted pendulum, in such a manner that the two bobs move together in any horizontal direction. This combination of a stable with an unstable mass can be adjusted to give any desired degree of astaticism. In practice it is convenient to allow the joint mass to have a free period of from five to ten seconds, the period of ordinary earthquake waves being much less than this. A long and light lever, pivoted to the frame of the instrument at one point, and to the steady mass at another, forms a registering index, by which a magnified trace of the earth's horizontal movement is deposited on a fixed plate of smoked glass with the least possible friction.

In another instrument two components of horizontal motion are separately determined, each by a horizontal pendulum, tilted slightly forwards to give a small degree of stability, and furnished with a multiplying pointer. In this instrument the pointers trace the successive movements of the earth on a plate of smoked glass which is kept revolving uniformly by clockwork. The velocity and acceleration of the movements are deducible from the records. This is the standard form of seismograph employed by the writer, and, to make the information it gives complete, another instrument for registering (on the same plate) the vertical motion of the ground is added.

The vertical-motion seismograph is a horizontal lever, supported on a horizontal fixed axis, and carrying at one end a heavy mass. A spring attached to a fixed point above holds up the lever by pulling on a point near the fulcrum. To make the mass nearly astatic the point at which the spring's pull is applied is situated below the horizontal line of the lever, so that when the spring, by (say) being lengthened, pulls with more force, the point of application moves nearer the fulcrum, and the moment of the pull remains very nearly equal to the moment of the weight.

Apart from its application to palpable earthquakes the inertia method is to be applied to minute earth-tremors of the kind observed in Italy by Bertelli and Rossi, which are probably to be found wherever, and whenever, one searches for them with sufficient care. But in dealing with them no mechanical means of recording can well be applied, on account of its friction, and a still more frictionless method of suspending the heavy mass is desirable. The writer prefers for this purpose a mode of suspension based on Tchebicheff's approximate straight-line motion; and to detect the movement of the ground he observes, by a microscope fixed rigidly to the frame of the machine, the displacement of the frame with respect to the suspended mass. This is Bertelli's method, except for the substitution of a nearly astatic mass for the stable mass used by him—namely, the bob of a short pendulum—which of course gives a mi leading magnification of certain vibrations.

The writer was recently requested by the Directors of the Ben Nevis Observatory to design seismometers for use there, and obtained a Government grant for their construction. The equipment at Ben Nevis will include recording-seismographs, and a micro-seismometer of the kind just described. To measure slow earth-tiltings an instrument is being constructed in which a modification (due to Wolf) of d'Abbadie's arrangement (described in Prof. Darwin's Reports) is followed. Light from a lamp travels some twenty feet horizontally to a mirror inclined at 45° to the horizon. It passes vertically down through a lens which brings the rays into parallelism. They then strike two reflecting surfaces—one the surface of a basin of mercury, the other a plane mirror very rigidly fixed to the rock. The rays come back to form two images near the source, and any relative displacement of the two images is measured by a micrometer-microscope. In the choice and design of this instrument the writer has to acknowledge much assistance from Prof. G. H. Darwin. This apparatus, like the others, was intended for Ben Nevis, but a visit to the Observatory there has convinced the writer that to use it on that site, and in the atmosphere which prevails on the top, would be a matter of extreme difficulty, and that, in the first instance at least, observations should be made with it on lower ground.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE. — Prof. P. G. Tait has been elected an Honorary Fellow of Peterhouse; and Mr. T. T. Jeffery, M.A., a Fellow of the same College.

Mr. J. Larmor, M.A., of St. John's College, has been appointed one of the University Lecturers in Mathematics, and also Examiner for the First Part of the Mathematical Tripos of 1886.

The Syndicate appointed to re-arrange the additional subjects of the Previous Examination have reported in favour of adding Elementary Dynamics to Statics, and reducing the Trigonometry to what is needed for the Examination in Mechanics; Mathematical Honour students, they recommend, shall no longer be required to pass this Examination, but instead be required to pass in either French or German. Physical Science and Biology are still to receive no recognition even as optional subjects.

Dr. Burghardt, Lecturer in Mineralogy in Owens College, Manchester, is appointed to examine in Mineralogy in the Natural Sciences Tripos; Prof. Ray Lankester, F.R.S., to examine in Zoology and Comparative Anatomy in the same Tripos, the First M.B., and the Special Examinations.

Christ's College offers Scholarships and Exhibitions for Natural Science, the Examination beginning January 5, 1886. The Examinations at Jesus College begin on the same day.

The Special Boards for Physics and Chemistry and for Biology and Geology have issued the following notice with regard to the First Part of the Natural Sciences Tripos:—

In Part I. of the Examination all the questions will be of a comparatively elementary character, and will be such as to test a knowledge of principles rather than of details. Specimens may be exhibited for description and determination.

In Physics the questions will be limited to the elementary and fundamental parts of the subject, and, in particular, special attention will be paid to the definition of physical quantities, the general principles of measurement, the configuration and motion of a material system, the laws of motion, the comparison of forces and of masses, and the properties of bodies. In Sound, Light, Heat, Electricity and Magnetism, only the fundamental laws, their simpler applications, and the experiments which illustrate them, will be required.

In Chemistry the questions will relate to the leading principles and experimental laws of Chemistry, the properties of the commoner elements and their principal compounds, the outlines of Metallurgy, and simple qualitative and quantitative analysis.

In Mineralogy the questions will be confined to elementary Crystallography, the general properties of minerals and the special characters of those species only which are of common occurrence or of well-known mineralogical importance.

In Geology the questions will be limited to Physical Geography, the interpretation of the structure of the crust of the earth and the history of its formation, so far as to involve only the elementary parts of Palæontology and Petrography.

In Botany the questions will relate to the elementary parts of Vegetable Morphology, Histology, and Physiology; and to the principles of a natural system of classification as illustrated by the more important British natural orders. Candidates will be required to describe plants in technical language. Questions